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Report to the Chairman, Committee on Government Operations
House of Representatives

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DATA MANAGEMENT

DOD Should Redirect Its Efforts to Automate Technical Data Repositories

GAO/IMTEC-86-7

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United States
General Accounting Office
Washington, D.C. 20548

Comptroller General
of the United States

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March 13, 1986

The Honorable Jack Brooks
Chairman, Committee on Government
Operations
House of Representatives

Dear Mr. Chairman:

This report responds to your May 24, 1985, request that we review the Department of Defense's technical data repository automation efforts and include information on technology sharing between the Department of Defense and the Patent and Trademark Office relating to these efforts.

As arranged with your office, unless you publicly announce the contents of this report, we plan no further distribution of the report until 30 days from its issue date. We will then send copies to the Chairmen, Senate and House Committees on Appropriations and Senate Committee on Governmental Affairs; Secretaries of Defense and the military departments; Director of the Defense Logistics Agency; Commissioner of the Patent and Trademark Office; Director of the Office of Management and Budget; Administrator of General Services; and other interested parties; and will make copies available to others upon request.

Sincerely yours,

Charles A. Bowsher

Charles A. Bowsher
Comptroller General
of the United States

Executive Summary

The Department of Defense's (DOD) technical data repositories (storage centers) are critical to increasing competition in DOD's approximately $22-billion annual spare-parts procurement process. Technical data include the specifications, engineering drawings, descriptions of manufacturing processes, and testing procedures necessary to competitively procure spare parts. Concern about DOD's technical data problems and their effect on competition for spare-parts procurements prompted the Chairman of the House Committee on Government Operations to ask GAO to determine whether

- DOD's management of technical data repository automation efforts is adequate and whether these efforts should be consolidated into a single program managed at the DOD level;
- current repository automation efforts by the military departments and the Defense Logistics Agency (DLA) are well defined, are based on validated requirements, and have used appropriate procurement methods; and
- DOD and the Patent and Trademark Office (PTO) should share studies (to include testing) of new technology.

Background

For many years the Congress has advocated the use of full and open competition to reduce the cost of spare parts. Just as competition is critical to reducing procurement costs, the availability of technical data is a necessary element in conducting competitive procurements for spare parts. DOD determined that the automation of its technical data repositories was required to overcome problems with its manual processes and outdated electro-mechanical devices for storing aperture cards. In 1983, the Secretary of Defense issued general guidance on automating technical data repositories. This guidance called for standardized systems that could communicate with one another (interoperate) using modern computer technology. The three military departments and DLA have initiated 5 separate efforts to automate 25 primary repositories.

DOD estimates this automation will cost $144 million through fiscal year 1989.

Results in Brief

DOD's overall management efforts for technical data repository automation will not ensure the most efficient and effective solution to repository problems. DOD is not likely to achieve its goals of standardization and interoperability of primary technical data repositories. (See pp. 18 to 25.)

In acquiring computer hardware and software for their projects, the military departments and DLA did not comply, in all cases, with regulations implementing the Brooks Act. Furthermore, these automation efforts are generally not adequately defined, validated, or based on reasonable economic justifications. (See pp. 26 to 37.)

DOD and PTO have not formally shared studies of new technology. (See pp. 38 to 42.)

Principal Findings

Duplicative and Nonstandard Approaches

The five DOD efforts under way (three Navy, one joint Army/Air Force, and one DLA project) have resulted in duplicative and nonstandard approaches to automating repositories. For example, the Army/Air Force and the Navy are pursuing independent digital projects, whereas DLA's project does not include digital systems because the agency believes the technology is unproven. The net result is systems that are nonstandard which will, in turn, jeopardize interoperability.

Requirements Not Adequately Defined

Because DLA underestimated repository work loads, it acquired computer equipment that does not meet its needs. The Army/Air Force joint development effort and one of the Navy's efforts required numerous contract modifications because of added requirements. (See pp. 26 to 29.)

Economic Analyses Not Adequate

DOD regulations require an economic analysis for such projects as the technical data automation. Although the military departments and DLA each developed one or more economic analyses, GAO found, in several instances, that these analyses were incomplete, were outdated, or contained invalid assumptions. For example, the Army incorrectly used productivity information and overstated automation benefits by 34 percent. (See pp. 29 to 33.)

Regulations Not Complied With

Federal regulations and DOD directives require DOD agencies to adopt a procurement strategy that not only meets their needs but also protects the government's interests. To achieve this, federal regulations require

agencies to obtain a Delegation of Procurement Authority from the General Services Administration before purchasing computer equipment or services. The Army and Navy did not obtain, in all cases, required Delegations of Procurement Authority to buy computer hardware and software for automating their repositories. Army officials believed their procurement was covered by federal printing regulations instead of computer procurement regulations, and Navy officials believed their procurement involved only minimal amounts of computer hardware. Although DLA obtained a Delegation of Procurement Authority for its repository automation project, it exceeded this authority by, among other things, acquiring four systems instead of the two systems authorized by the delegation. The General Services Administration disagrees with the military departments and believes that Delegations of Procurement Authority should have been obtained. Moreover, the agency believes that DLA exceeded its authority and should have requested an updated delegation. GAO agrees with the General Services Administration. (See pp. 33 to 35.)

Competition Restricted

The joint Army/Air Force effort's Request for Proposals contained unnecessarily restrictive requirements for computer hardware and software. This action limited the types of computers that could be offered by prospective bidders; thus, full and open competition, a basic goal of federal procurement regulations, was not obtained for these requirements. (See pp. 35 and 36.)

Information Not Shared

DOD and PTO have similar needs for optical disks, a new technology for storing large amounts of data. But they did not formally consider joint studies or testing, resulting in a duplication of effort. (See pp. 38 to 42.)

Recommendations

GAO recommends that the Secretary of Defense direct the Assistant Secretary of Defense for Acquisition and Logistics to take the following actions:

- In conjunction with the Assistant Secretary of Defense (Comptroller), expeditiously evaluate the appropriateness of continuing any or all current technical data repository automation efforts, considering the findings of this report and the Secretary's goal of standardization and interoperability. Results of this evaluation, including actions taken to delay or terminate any or all efforts, and the associated budgetary impacts should be presented to selected congressional committees.

- Following the evaluation, designate oversight responsibility to a central office within the Office of the Secretary of Defense to manage and control any continuing efforts to automate the military departments' and DLA's repositories. This central office should have planning, coordination, and budget review and approval authority over the remaining military department and DLA repository automation efforts, and should obtain Delegations of Procurement Authority as required by law.
- Formally coordinate with PTO's Administrator for ADP, and, when appropriate, perform joint studies (including testing) of optical-disk storage devices.

GAO also recommends that the Congress delay any further funding of the technical data repository automation efforts until it receives the DOD evaluation. Additionally, GAO recommends that, after reviewing the evaluation and determining appropriate funding levels, the Congress ensure that these funds be restricted to the centrally directed effort. (See chapter 5.)

Agency Comments

GAO did not request official agency comments on a draft of this report. However, during the course of its work, GAO discussed the facts in this report with agency program officials and has incorporated their comments where appropriate.

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Abbreviations

ADP	automatic data processing
CALS	Computer Aided Logistics Support
DLA	Defense Logistics Agency
DOD	Department of Defense
DSREDS/ EDCARS	Digital Storage and Retrieval Engineering Data System/ Engineering Drawing Computer Assisted Retrieval System
EDASRE	Engineering Drawing Automated Storage and Retrieval Equipment
EDMICS	Engineering Drawing Management Information and Control System
GAO	General Accounting Office
MAISRC	Major Automated Information Systems Review Council
NAVAIR	Naval Air Systems Command
NAVSEA	Naval Sea Systems Command
PTO	Patent and Trademark Office

Introduction

Each year the Department of Defense (DOD) spends billions of dollars on spare parts for military weapon systems and other equipment. In fiscal year 1984, DOD's spare-parts procurement budget was estimated at $22 billion. DOD buys these spare parts during two phases of a weapon system's life cycle—when the system is new (initial spares) and after it has been in inventory for a certain period (replenishment spares). As figure 1.1 shows, over the entire life cycle of a weapon system, the vast majority of spare-parts procurement dollars typically will be devoted to replenishment spares.

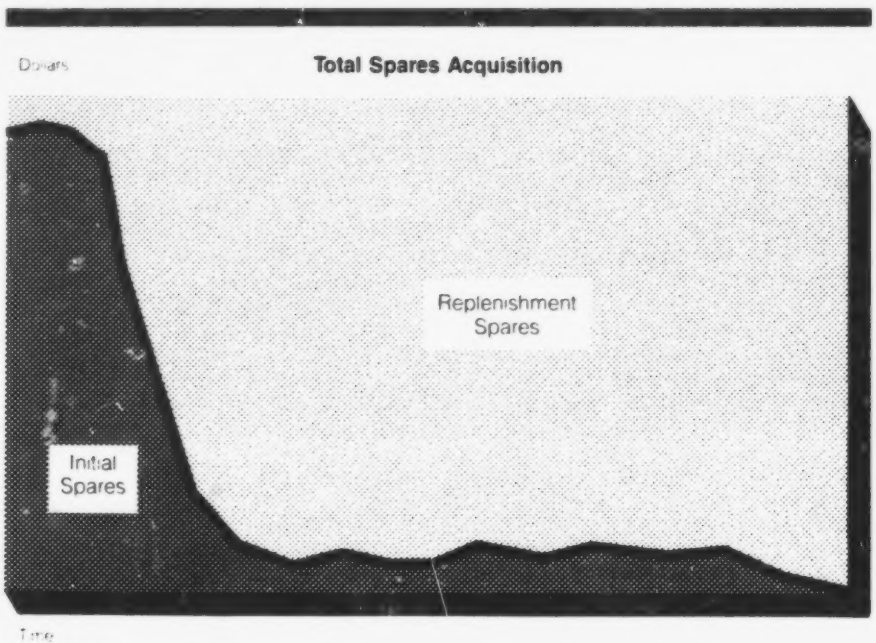


Figure 1.1: Typical Phasing of Initial and Replenishment Spare-Parts Acquisitions

Source: Office of Federal Procurement Policy

In the early 1980s, the media and congressional hearings attracted the public's attention to overpricing problems relating to DOD's spare-parts acquisitions. One of the results of this publicity was additional focus by DOD on its spare-parts pricing problems and the accompanying insight that technical data repository automation might partially solve the problems. During this same time, several repositories were developing plans for modernizing their older and increasingly-difficult-to-maintain technical data storage equipment. In August 1983, the Secretary of

Defense issued general guidance for improving spare-parts procurements and included in this guidance limited direction for automating the technical data repositories.

Technical Data and Its Relationship to Spare-Parts Procurements

For many years, the Congress has advocated the use of full and open competition to encourage federal agencies to obtain goods and services at the lowest total overall cost. The Office of Federal Procurement Policy has estimated that procurement savings of 20 percent could be obtained through competition. In addition, competition may encourage better quality and more timely deliveries. Just as competition is critical to containing procurement costs, technical data are a necessary element in conducting competitive procurements with private industry. To solicit competition, the government's buying office must furnish a detailed description of an item, often including its performance characteristics. This information, generally termed technical data in DOD, includes specifications, detailed engineering drawing(s), manufacturing processes, and testing procedures. DOD's current efforts to improve spare-parts pricing have underscored the importance of technical data for competitive spare-parts procurements.

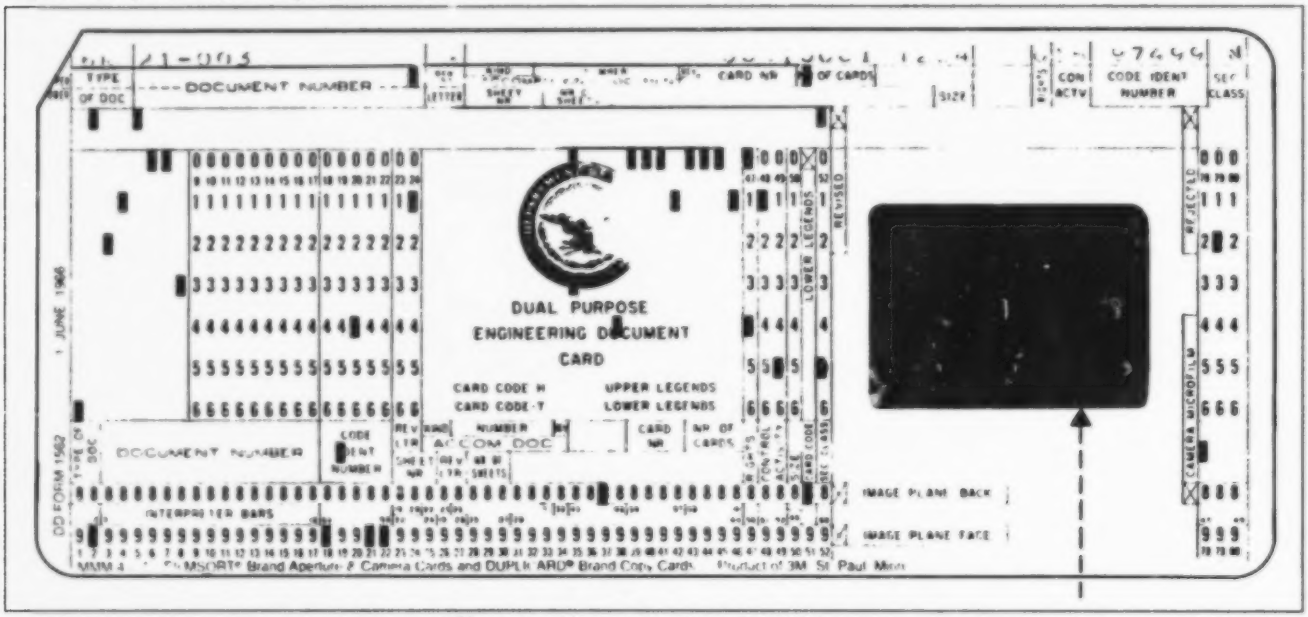
The Mission of DOD's Technical Data Repositories

The military departments and the Defense Logistics Agency (DLA) have established repositories to manage technical data. DOD has designated 25 primary repositories that support procurements of spare parts. These repositories manage the receipt, inspection, indexing, and storage of technical data and the responses to requests for these data. Approximately 80 percent of data requests support spare-parts procurements; the remaining 20 percent are for engineering modifications, manufacturing, and maintenance support. Additionally, these repositories provide data to industry, the public, and foreign military assistance organizations. DOD also has several secondary repositories that mostly support engineering modifications and maintenance functions of the military departments.

Since conversion from paper-copy storage during the early 1960s, DOD repositories have relied on aperture cards as their primary data-storage medium. An aperture card is a standard 80-column, data-storage card with a 35-millimeter filmstrip mounted on the card containing a picture of the engineering drawing or specification. (See figure 1.2. on next page.)

Approximately 90 percent of the data stored in the DOD repositories is on aperture cards; the balance is stored on roll microfilm or on paper copy or both. Depending on the size of the drawing, the aperture card may contain information on one drawing, several drawings, or only a segment of a drawing. Currently, DOD estimates that its primary repositories store 200 million drawings, with the associated specifications and documented manufacturing and testing processes. Most of DOD's technical data repositories rely on manual or older computer-controlled, aperture-card storage and retrieval operations.

Figure 1.2: Aperture Card Representation



A 35-mm. filmstrip containing the technical data (engineering drawing or specification) is mounted on the card

DOD Reported Deficiencies in the Military Departments' And DLA's Repository Operations

According to DOD, manual operations have made it difficult for repository managers to provide timely service to data requesters. Currently, data stored on aperture cards are largely handled manually or by old computer controlled, aperture-card storage and handling devices. Repository operations have become untimely and cumbersome as greater quantities of cards are stored and as an increased use of competitive procurements drives the number of data requests upward. These actions

have caused problems in retrieving, from the system, necessary data for procurements. In some cases, data have been misplaced, thus delaying information provided to contractors seeking to bid on spare-parts procurements. Further, aperture-card handling equipment for existing repositories is old, resulting in frequent maintenance problems. In some cases, because this equipment is no longer manufactured, replacement by similar equipment is not possible. Other problems reported include inadequate and lost drawings, inadequate technical characteristics for manufacture, and inadequate testing procedures.

Automation Efforts by the Military Departments and DLA

In an attempt to resolve some of the aforementioned problems, the military departments and DLA have initiated projects to automate 25 primary repositories. DOD estimates that these projects will cost $144 million through fiscal year 1989. The projects are intended to address only the storage and retrieval problems of current drawings and will not focus on adequacy and completeness of the drawings or of other technical data. Table 1.1 shows the status of the military departments' and DLA's automation efforts.

Table 1.1: Automation of DOD's Primary Technical Data Repositories

Dollars in millions

	No. to be automated	Estimated costs
Military departments		
Air Force	5	$38.2
Army	7	40.4
Navy	9	53.7
DLA	4	11.7
Total	**25**	**$144.0**

	On contract	Contract options	Planned
Military departments			
Air Force	1	4	•
Army	1	6	•
Navy	2	•	7
DLA	4	•	•
Total	**8**	**10**	**7**

Note: The first installation of automated equipment took place in January 1986 at the Naval Air Technical Services Facility, Philadelphia, Pennsylvania. Final installation is planned for the first quarter of fiscal year 1989 at the Naval Electronics Systems Engineering Center, Portsmouth, Virginia.

Some repositories are planning to utilize digital storage devices; they will convert existing engineering drawings and specifications to electronic pulses—a process known as digitization. Once the data are digitized, the electronic pulses, representing the drawings or specifications, can be stored, for future retrieval, in either magnetic or optical devices. The magnetic storage device records the electronic pulses on magnetically sensitive platters, while the optical device uses lasers to record these pulses on light-sensitive material. (See chapter 4 for further elaboration on the optical-disk technology.) Figure 1.3 shows the different types of automated technology planned or installed.

The military departments' and DLA's automation efforts are summarized below.

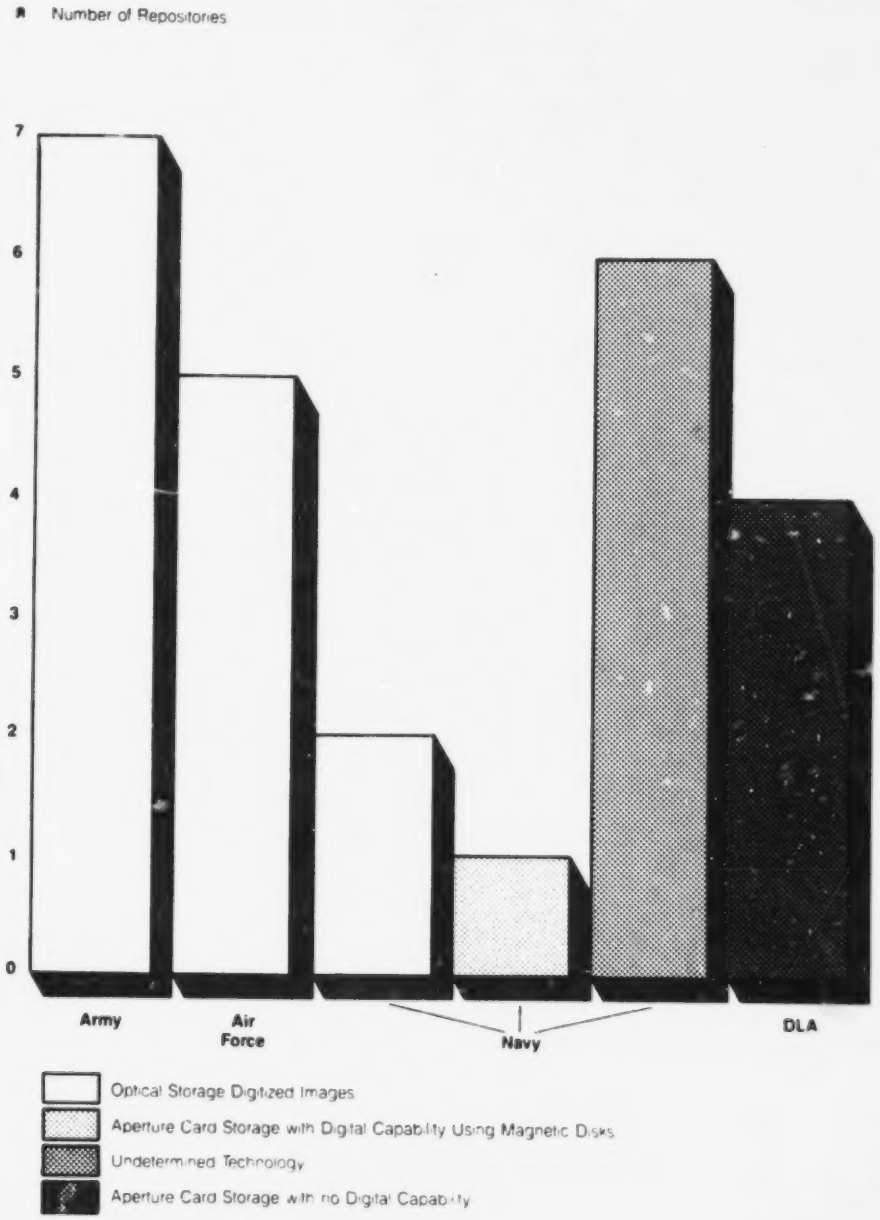
Army/Air Force

The Army's and Air Force's Digital Storage and Retrieval Engineering Data System/Engineering Drawing Computer Assisted Retrieval System (DSREDS/EDCARS) is a prototype system intended to digitally store, update, retrieve, and duplicate engineering drawings and related documents using optical-disk technology. The system will be installed at the Army's seven major commands and at five Air Force logistics centers that support spare-parts procurements. The first installations will be at the U.S. Army Missile Command in Huntsville, Alabama, and at the Sacramento Air Force Logistics Center, starting in April 1986, with all projects planned to be installed and accepted by September 1988.

Navy

The Navy's Engineering Drawing Management Information and Control System (EDMICS) is a prototype system intended to store, update, retrieve, and duplicate engineering drawings and related specifications. Currently, the Navy has three separate projects using two types of technology within this system. The Naval Air System Command's (NAVAIR) Technical Services Facility in Philadelphia, Pennsylvania, is installing an aperture-card storage system, along with phasing in both magnetic and optical-disk storage devices. The Engineering Drawing Support Activities of the Naval Sea Systems Command (NAVSEA) are acquiring optical-disk storage systems: the site at Port Hueneme, California, awarded a contract in September 1985 and plans to install its system by the fourth quarter of fiscal year 1986; the Portsmouth, New Hampshire, site released the same Request for Proposals in September 1985. The Navy plans to develop a method by which these three systems can communicate with one another. It is also considering expanding EDMICS to secondary repositories, depots, and engineering facilities.

Figure 1.3: Types of Automated Technology Planned for or Installed at DOD's Repositories



DLA

DLA's Engineering Drawing Automated Storage and Retrieval Equipment (EDASRE) will automate two data repositories currently using manual operations—the Defense Electronics Supply Center in Dayton, Ohio, and the Defense General Supply Center in Richmond, Virginia. Two semiautomated repositories, the Defense Industrial Supply Center in Philadelphia, Pennsylvania, and the Defense Construction Supply Center in Columbus, Ohio, will be upgraded to be fully automated. The DLA system, which stores, updates, and retrieves engineering drawings and associated data, will use a closed-loop, aperture-card-based system. This process keeps the aperture card within the card-handling equipment, and makes copies of requested or needed information without human intervention. EDASRE is expected to be operational at all four centers by June 1986.

Objectives, Scope, and Methodology

Concern about DOD's problems in acquiring and managing technical data and the effect of these problems on competition for spare-parts procurements prompted the Chairman of the House Committee on Government Operations to ask us to evaluate selected aspects of technical data repository automation. In discussing the request with the committee, we agreed to determine whether

- DOD's management of technical data repository automation efforts is adequate;
- current independent automation efforts by the military departments and DLA are well defined, are based on validated user requirements, and have used appropriate procurement methods;
- these efforts should be consolidated into a single program managed at the DOD level; and
- DOD and the Patent and Trademark Office (PTO) should share studies, including testing, of new technology.

To answer these questions, we reviewed the DOD agencies' and PTO's automation plans and policies, evaluated each of DOD's major repository automation projects and a PTO project (Automated Patent System) that employs technology similar to that used by DOD, and interviewed DOD and PTO officials responsible for the automation efforts identified in this report. In gathering and analyzing DOD and PTO documents concerning the acquisition of automatic data processing (ADP) hardware and software, we talked with appropriate agency officials and their staff. To ascertain the adequacy of DOD-level management, we obtained and analyzed documents and interviewed officials of the Office of the Secretary

of Defense (Comptroller); the Defense Material Specifications and Standards Office; and military department and DLA officials responsible for managing technical data and ADP resources.

To determine if the military departments' and DLA's automation efforts were well defined, were based on validated requirements, and used appropriate procurement methods, we examined the processes used and documentation created by military department and DLA repository automation efforts under way and compared these to applicable military, DLA, DOD, and government regulations on software design and development and computer equipment procurements.

To find out if the military departments' and DLA's automation efforts should be consolidated into a single program managed at the DOD level, we compared the projects' current status to reported criteria concerning success or failure of jointly managed DOD programs. The criteria we relied on were outlined in two reports: Joint Major System Acquisition by the Military Services: An Elusive Strategy (GAO/NSIAD-84-22, Dec. 23, 1983) and Report of the Defense Science Board 1983 Summer Study on Joint Service Acquisition Programs (Feb. 1984). Additionally, we relied on criteria contained in an August 1983 memorandum from the Secretary of Defense concerning automation of DOD's primary repositories, and DOD regulations pertaining to life-cycle management of automated information systems.

To evaluate whether the DOD agencies and PTO should share studies (to include testing) of new technology, we identified similarities and differences between the military departments' and DLA's projects and PTO's Automated Patent System project. We also reviewed the management actions of these agencies in relation to the requirements of the Paperwork Reduction Act of 1980, Public Law 96-511, and Office of Management and Budget Circular A-71 concerning inter- and intra-agency technology and automated systems sharing.

In addition to performing this work for the Chairman, House Committee on Government Operations, we are also evaluating a DOD plan for an improved system for managing technical data. Both the DOD plan and our evaluation, which is to be completed in April 1986, are required by Public Law 98-525, the 1985 Department of Defense Authorization Act.

We sought the views of numerous responsible agency program officials during the course of our work. However, in accordance with the requester's wishes, we did not obtain the views of these officials on our

findings, conclusions, and recommendations; nor did we request official agency comments. Except as noted above, we performed our work in accordance with generally accepted government auditing standards.

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Comprehensive Strategy Needed For Repository Automation

For years, congressional concern has focused on the need for DOD to eliminate overlapping and duplicative functions whenever and wherever possible—particularly in the areas of supply and ADP. Standardization can be an effective means of reducing overlapping or duplicative ADP functions; it can involve multiple sites using either the same systems or the same system components to meet mission needs. In implementing standard systems or components, organizations can reduce costs by eliminating duplicative research and development, consolidating maintenance expenses, and enhancing opportunities for interoperability.[1]

The DOD technical data repositories fundamentally perform the same missions and have similar work loads; therefore, automation efforts at these repositories could benefit from standardization. However, DOD's efforts to standardize repository automation have suffered from inadequate management direction which, in turn, has contributed to duplicative and nonstandard development and may jeopardize opportunities for interoperability between DOD repositories and with industry.

Repository Representatives Indicate Mission Functions Are the Same

According to key DOD repository representatives, DOD's technical data repositories perform virtually the same tasks, have similar work-load characteristics, and face common problems. In October 1982, key representatives from the military departments, DLA, and the Office of the Secretary of Defense met to review the military departments' and DLA's repository automation projects. During that meeting, the representatives determined that

- the primary function of their repositories was to receive, inspect, index, and store technical data and then provide these data to requesters on time;
- approximately 80 percent of their work load involved providing data for spare-parts procurements; the remaining 20 percent involved providing data to support weapon system maintenance, modification, and development; and
- the repositories faced common problems (i.e., work loads exceeding available resources and cumbersome manual operations) that prevented them from functioning in a timely manner.

[1]Interoperability, as it relates to DOD technical data repositories would, at a minimum, permit individual repository computer systems to electronically exchange data with one another and with private industry.

The representatives concluded that automation was the best solution to their repository problems and that a standard system could be used to automate all of their repositories.

Policy Direction for Repository Automation Has Not Been Adequately Implemented

The Secretary of Defense has provided general direction to the military departments and defense agencies on standardizing repository automation. In an August 1983 memorandum, the Secretary stated that a standard computer system specification had been defined, and he directed the military departments to fund an automation effort to install two separate prototypes—one prototype for one Army and one Air Force repository and another prototype for NAVAIR's central repository. Additionally, the Secretary stated that automating repositories with state-of-the-art technology would enable DOD to exchange technical data electronically with industry and with the military departments and DLA.

Although the Secretary has provided policy direction, the Defense Material Standards and Specifications Office[2], which is responsible for technical data management, has not developed the necessary comprehensive strategy or issued implementation guidance to carry out the Secretary's instructions effectively and efficiently. The reason: officials of this office stated that they believed the Secretary's August 1983 memorandum needed no further elaboration, and they assumed that all organizations interested in automating their repositories would join one of the prototype projects.

In our opinion, however, the Secretary's policy guidance was not as clear as the Defense Material Standards and Specifications Office believed. For example, the Secretary did not direct DLA to join one of the military departments' prototype projects. Nor did he say how other organizations interested in automating their repositories could join prototype projects.

For other organizations to join either prototype they would have had to form a joint acquisition with either the Army/Air Force or the Navy to acquire a system to automate their repositories. Yet establishing a successful joint acquisition is not an easy task. We and the Defense Science

[2]Before June 1985 the Defense Material Standards and Specifications Office was within the Office of the Under Secretary of Defense for Research and Engineering; it is now within the newly established Office of the Assistant Secretary of Defense for Acquisition and Logistics.

Board, the senior independent advisory body to DOD, have reported[3] that the initial requirement preparation phase for a joint acquisition, while critical to an acquisition's success, is difficult to implement. The board also reported that this joint acquisition phase involves prospective participants reaching agreement on numerous critical issues including, for example, the performance specifications for the system, the technology to be used in developing the system, the acquisition strategy, and cost and schedule. According to the board, prospective participants need to agree on these issues before starting the acquisition to ensure its success.

In our opinion, definitive guidance was lacking on how the Secretary's direction was to be implemented and on DLA's role regarding the prototype projects. In addition, DOD has not developed a long-range strategy to guide the coordination of the establishment of expected joint acquisitions; nor has it provided guidance to organizations interested in joining the prototype projects at a later date.

Duplicative and Nonstandard Repository Automation Efforts Occurring

Without specific guidance, the military departments and DLA have individually interpreted how to implement the Secretary's policy direction on repository automation. As a result, the military and DLA are pursuing duplicative and nonstandard approaches in automating their five technical data repositories. Two examples follow.

NAVSEA, a Navy command, determined that the Army/Air Force specification met its requirements. But it was unable to join the prototype effort because the Army and Air Force were unwilling to delay their project to wait for uncertain NAVSEA funding. NAVSEA could not obtain funding and authorization approval from the Navy in time to include three of its repositories in the joint Army/Air Force prototype acquisition. Consequently, NAVSEA is using a slightly modified version of the Army/Air Force specification to automate two of its repositories under separate contracts at an estimated cost of $7 million. The NAVSEA projects use the same technology as used in the Army/Air Force project and, in our opinion, are duplicating the Army/Air Force effort. In addition, we believe that developing these efforts separately will jeopardize standardization and interoperability objectives.

[3]Joint Major System Acquisition by the Military Services: An Elusive Strategy (GAO/NSIAD-84-22, Dec. 23, 1983); Report of the Defense Science Board 1983 Summary Study on Joint Service Acquisition Programs (Defense Science Board, Feb. 1984).

DLA has not joined either prototype project because of its interpretation of the Secretary's policy guidance. According to DLA officials responsible for repository automation efforts, the Secretary tasked only the military departments to fund and support the prototype projects. DLA officials contend that the Secretary, in his general guidance, directed everyone to automate their repositories but did not specifically direct DLA to be a participant in either prototype project. Currently, DLA is independently developing its own automated aperture-card system. Further, DLA's current contract does not require digital capability, even though the prototypes mentioned by the Secretary call for a digital subsystem. This will result in a system not compatible with the other DOD digital systems under development. DLA's system does not include digital capability because the agency was concerned about the risk of using unproven technology.

Interoperability Among Repositories and Private Industry Has Been Jeopardized

In his August 1983 memorandum, the Secretary of Defense stated that automating repositories with state-of-the-art technology could permit the repositories to interoperate with other repositories and industry. The DLA system may jeopardize the Secretary's desire for interoperability. At a minimum, digitization is required for all systems to permit electronic communications of drawings among the repositories and industry. Because it is not digitized, the DLA system will not be able to exchange data electronically with Army/Air Force or Navy systems, or with private-sector digital systems.

DOD describes two levels of interoperability. One definition involves systems that simply pass information back and forth. Another definition involves systems so tightly integrated that they can operate together on the same data. DOD, however, has not established an adequate implementation strategy that would permit a logical and controlled evolution to achieve either form of interoperability for technical data repositories.

Management Strategy Needed for Future Standardization

Developing standard automated technical data repositories that can interoperate with other DOD repositories and industry, in our opinion, presents a significant management challenge. Since achieving these capabilities requires participation by DOD and the private sector for the initiation, development, and deployment of these automated systems, the level of the office from which these efforts are managed is extremely important. Two mechanisms are already in place with which

DOD can pursue its standardization goal. The first, a management concept designated Life Cycle Management of Automated Information Systems, provides a series of decision points for implementing major automation efforts. The second is the Major Automated Information Systems Review Council (MAISRC), chaired by the Assistant Secretary of Defense (Comptroller), which reviews and approves selected DOD automated information systems.

During fiscal year 1986 DOD appropriation hearings, the House Committee on Appropriations stated that the Assistant Secretary of Defense for Acquisition and Logistics should take the lead policy role for ensuring maximum coordination and compatibility between the services' logistics systems, of which repositories are a part, by developing and issuing minimum standards necessary to achieve this goal. The Committee further suggested that DOD, through its MAISRC, review the logistics automated systems to ensure that compatibility standards are enforced.

Management Strategy Lacks Oversight Control

Although DOD has implemented a management strategy for achieving interoperability among its repositories, the strategy does not include the necessary oversight control. In June 1985 the Assistant Secretary of Defense for Manpower, Installations, and Logistics (reorganized as the Assistant Secretary of Defense for Acquisition and Logistics) issued a report of the Joint Industry-DOD Task Force on Computer Aided Logistics Support (CALS).[4] This report discussed a strategy for obtaining interoperability among users of technical information, including technical data repositories. In September 1985 the Deputy Secretary of Defense approved a strategy for effecting the improvements recommended in the CALS report.

The CALS report recommended five options to achieve DOD-wide and industry coordination for system integration of repository functions. These options included establishing

1. Lead-service designation - oversight by the Office of the Secretary of Defense would be by customary budget review process.

[4]Report of the Joint Industry-DOD Task Force on Computer Aided Logistics Support (CALS) (Institute For Defense Analysis, June 1985).

2. Service coordination offices - coordination would be performed by a joint advisory group comprised of personnel from the Office of the Secretary of Defense, military departments, and private industry.

3. DOD steering group - would have planning and program approval authority over all service and DLA actions.

4. DOD joint program office - would include features of options #2 and #3 and would have funding authority to implement the entire program.

5. Office of the Secretary of Defense-level implementation office - assigns all authority and resources to the Office of the Secretary of Defense.

The report noted that these options were in order of increasingly effective integration and centralized control and that options #1 and #2 would be inadequate.

The Deputy Secretary of Defense did not implement any of the above options; instead, he appointed a steering group with coordination responsibility, but without the program and planning authority recommended by the task force report. Therefore, this group does not have the minimum acceptable level of centralized control recommended by the task force to ensure that effective systems interoperability occurs.

Life-Cycle Management and MAISRC Oversight Needed

The Office of the Secretary of Defense has issued guidance to ensure that automated information systems are effectively and efficiently managed. DOD Directive 7920.1, Life Cycle Management of Automated Information Systems, and the accompanying DOD Instruction 7920.2, Major Automated Information Systems Approval Process, respectively, establish a life-cycle management approach for ADP and a MAISRC review and approval process for major milestones during the life cycle of an automated information system. This management process is performed for selected automated information systems to ensure that the developing organization has fully considered functional, ADP, and telecommunications requirements in order to produce an effective system. The process seeks to (1) achieve accountability for the success or failure of an automated information system; (2) ensure that the automated information system is developed, evaluated, and operated effectively and at the lowest overall cost; (3) provide visibility for all resource requirements of an automated information system and communication with the Congress

early in acquisition process; and (4) promote standardization of automated information systems for use throughout DOD.

Life-Cycle Management of Automated Information Systems

The DOD directive for life-cycle management defines five life-cycle phases, the first two of which are the Mission Analysis/Project Initiation phase and the Concept Development phase. The purpose of the Mission Analysis/Project Initiation phase is to identify, document, and validate functional mission requirements or need, and recommend exploration of alternative concepts to satisfy the need. The purpose of the Concept Development phase is to solicit and evaluate alternative methods to accomplish the functional need described in the first phase. Competitive demonstrations or prototypes can be used in this phase to verify that the chosen concepts are sound, could perform in an operational environment, and provide a basis for final selection of a concept.

The Secretary of Defense, as noted earlier, has designated two prototypes for the automation of the technical data repositories. The two prototypes are proposing different types of digital technology. DOD has initiated these prototypes before thoroughly analyzing all of its technical-data automation requirements. As we discuss in greater detail in chapter 3, the military departments and DLA have not performed adequate requirements and economic analyses to initiate and justify their individual automation projects. The Army/Air Force project is using optical-disk technology and plans to digitize all of its existing drawings immediately. The NAVAIR project calls for multiple-storage mediums, including automated aperture card, magnetic disk, and eventually optical disk when proven acceptable. The NAVAIR project also plans to digitize data only when requests for data are made by various data users. Currently there is no plan to compare these projects and subsequently select one for use throughout the military departments' and DLA's technical data repositories.

MAISRC Review

DOD has instituted the MAISRC review process to ensure that the provisions of automated information system life-cycle management are instituted and followed. The DOD directive and instruction direct that an automated information system meeting one or more of the following criteria is subject to a MAISRC review:

- Has anticipated costs in excess of $100 million from initiation to installation.
- Has estimated costs in excess of $25 million in a single year.

- Is designated as being of special interest by the Office of the Secretary of Defense.

During our review, we found that the Air Force repository automation project, estimated to cost $38.2 million, received a MAISRC review. This project was reviewed because the Air Force had included it as part of a larger ADP modernization effort, with an estimated life-cycle cost over $1.7 billion. The Army, Navy, and DLA repository automation efforts, ranging from over $11 million to $53 million, did not receive a MAISRC review. However, if these efforts were considered as a single DOD-wide project, and their estimated costs combined, they would meet the $100-million threshold for a MAISRC review. Not only do the repository automation projects, combined, meet established cost thresholds, and therefore warrant a MAISRC review, but they were also designated as being of special interest by the Office of the Secretary of Defense. In his August 1983 memorandum, the Secretary of Defense determined that automating the repositories was essential to planned improvements for spare-parts procurements. He also indicated that a standard system specification had been developed for the repository automation efforts.

Federal ADP Acquisition Regulations and Procedures Were Not Fully Followed

Federal regulations and DOD directives, implementing Public Law 89-306 (Brooks Act), require certain agency actions designed to ensure effective and efficient ADP management. Agencies are required to thoroughly identify, document, and validate system requirements before they purchase new ADP systems. All economically feasible alternatives must be considered. A procurement strategy, which meets organizational needs and protects the government's interests, must also be developed and followed.

The military departments and DLA did not, in all cases, follow the prescribed federal regulations and DOD directives pertaining to ADP acquisitions in automating their technical data repositories. Neither the military departments nor DLA fully identified, documented, or validated requirements. Consequently, economic analyses are generally incomplete, have invalid assumptions, or are out-of-date. In addition, the Army and Navy did not obtain Delegations of Procurement Authority from the General Services Administration, as required by the Federal Procurement Regulation,[5] and DLA exceeded its Delegation of Procurement Authority. Finally, in one of the five projects, contracting practices inappropriately restricted competition.

System Requirements Were Not Fully Analyzed or Validated

Federal Property Management Regulation, Subchapter F, Part 101-35, requires an agency to conduct a comprehensive requirements analysis commensurate with the complexity of the program objectives and mission needs before acquiring new ADP equipment. Additionally, DOD Directive 7920.1 requires the military departments and DLA to fully identify, document, and validate requirements before developing an automated system. To determine the requirements of a new or replacement system, agencies must look at their current problems; user needs; work-load requirements, including validation of existing work load; external requirements and constraints; and then identify possible solutions. The written version of the requirements analysis should, among other things, properly state user needs and minimum requirements and should not unduly restrict competition. The analysis should also be adequately documented to allow for periodic review and refinement of requirements.

[5]See 41 Code of Federal Regulations, Subparts 1-4.11 and 1-4.12, which were in effect when these requirements were being developed. On April 1, 1985, these provisions were replaced by the Federal Information Resources Management Regulation.

We found that the military departments' and DLA's efforts to analyze and validate their requirements fell short, as the following examples demonstrate.

Army/Air Force

Before the Army and Air Force formed a joint project, both organizations had conducted requirements analyses for the automation of their repositories. We found, however, that these analyses were prepared with limited user involvement and were based on inadequate user requirements documentation and on requirements that were not validated.

The Army did not document the extent of user involvement in its analysis and therefore cannot be assured that user requirements are fully identified or properly stated. The Army also did not validate its requirements. The Army program manager stated that, although the requirements analysis was not documented, he felt comfortable about how the requirements were identified and validated because of the extensive number of users involved. Further, he stated that, in his opinion, the approval process for the system served as a validation for the project's requirements. However, as previously mentioned, documentation of user requirements analysis and validation are necessary steps to ensure development of an effective automated information system. Furthermore, although the Army contracted during 1984 for automation of Army repositories, it currently has a separate contract study under way to identify the Army-wide technical data requirements of all Army users.

The Air Force's requirements analysis also did not initially involve users. The Air Force focused on repository operational problems, but it did not analyze users' information needs. The Air Force project manager stated that, since the repository was a service organization, automation would make the repository more responsive to users. We noted, however, that when Air Force users reviewed the system requirements after contract award, they identified a problem with the system's response time. The Air Force later changed the contract to add a local area network that would increase system response time.

Further, although the Air Force validated its automation requirements, this validation occurred in November 1984—3 months after the contract had been awarded. Additionally, the requirements document, submitted

for validation, did not address the functional requirements for command-wide engineering data indexing, location, requisition, and automatic bid set preparation (including data base loading).

By limiting or by not documenting the extent of user involvement, not fully identifying or analyzing technical data automation requirements, and not adequately validating their requirements before finalizing their contracts, both the Army and Air Force have increased the risk of implementing a less effective or potentially more costly system than one predicated on a thorough requirements analysis.

Navy

The Navy's effort to determine requirements for the NAVAIR project was incomplete because the Navy did not adequately involve users. While NAVAIR officials did include a representative from the contracting office on its team that developed requirements, they excluded representatives from the six naval air rework facilities, even though the NAVAIR repository identified these maintenance depots as primary users. However, after awarding the contract in 1984, NAVAIR identified the rework facilities' requirements and estimated that these requirements for equipment, networking, personnel, and maintenance will add $9.4 million to the total cost of the system. If these requirements had been identified and included in the original specifications to industry, NAVAIR could have obtained competitive responses and could possibly have been able to procure these requirements at lower costs.

Navy officials told us that NAVAIR's requirements were validated in a March 1984 analysis. We found, however, that the analysis was done primarily for a briefing to Navy's management on the technologies advocated by rival naval commands. That analysis contrasted risks and costs of two technology approaches: (1) aperture-card storage with phased-in digitization and (2) optical-disk storage, similar to that acquired by the Army and Air Force. The analysis did not discuss the redundant storage files and storage media at NAVAIR. As of December 1985, NAVAIR had three files containing 26 million cards, of which about 11 million were duplicates. According to NAVAIR officials, the three files are used to increase responsiveness by increasing card availability. Under this arrangement, the central repository responding to data requests could handle up to three simultaneous requests for the same cards by manually retrieving the same card from three potential locations.

NAVAIR plans to automate its repository, but it also plans to continue its current storage arrangement, which is predicated on a manual system.

NAVAIR's current acquisition strategy calls for maintaining the existing, manual, 26-million, aperture-card storage file while creating new files as automated aperture-card storage modules, magnetic disks, and optical-disk storage are phased in. According to NAVAIR officials, the command adopted this phased approach because of concerns about the risks associated with employing only digital storage devices (optical and magnetic disks). NAVAIR's approach, however, will produce a highly complex storage and retrieval environment because data will have to be controlled on four different storage mediums.

In our opinion, a proper validation of NAVAIR requirements would have questioned the need for redundant storage methods and their accompanying management-control problems.

DLA

DLA's requirements determination was inadequate because the agency used inaccurate and nonvalidated work-load statistics that did not include items transferred to DLA from the military departments. Although DLA officials knew of these transfers in early 1983, they failed to include them when they completed their requirements specification and let the contract in 1985. In our opinion, DLA had more than enough time to update and validate its work-load statistics since the transfer of 1 million cards occurred about 2 years before contract award. As a result of using inaccurate and nonvalidated work-load statistics, the storage capacity of four repositories is already undersized and will have to be augmented with additional storage modules. By acquiring additional storage equipment, DLA will be increasing the system's total cost.

Economic Analyses Are Incomplete, Invalid, or Outdated

The goal of the ADP acquisition process is to obtain a system that meets user requirements with the lowest overall cost, price and other factors considered. To meet this goal and to justify to management the expenditure of funds, DOD Instruction 7041.3, Economic Analysis and Program Evaluation for Resource Management, requires an economic analysis for proposals that involve a choice between two or more options. According to the guidance, an economic analysis is a systematic approach to the problem of choosing how to employ scarce resources and an investigation of the full implications of achieving a given objective in the most efficient and effective manner. Two features of the analysis are that (1) it covers the useful life of a system and (2) it should be updated as significant developments occur that affect costs or benefits.

To justify automation of their primary repositories, the military departments and DLA developed their own economic analyses of current and alternative methods of operation with varying degrees of adequacy. We found that these economic analyses contained incomplete, invalid, and outdated assumptions and information. Also, some analyses do not address capabilities that were later designed into the system.

Army/Air Force

To justify the automation of its seven repositories, the Army prepared an economic analysis for each repository, and then the Army Materiel Command consolidated them into one. We found that the benefits at two commands are overstated by about $3.3 million, the work-load data in two economic analyses are out-of-date, and the scope in all of the Army's seven analyses is too narrow.

One of the benefits of the proposed automation system was to be derived from the shortened time to revise a drawing compared to the current method. We found, however, that two commands overestimated savings for this benefit by claiming their productivity would increase by a factor of 20:1 for drawing revisions. The commands' projections were based on an article by a consulting firm[6] stating that, in repetitive drafting operations, and after a significant learning period, productivity could increase as much as 20:1. The article did not indicate how one could determine the productivity gain from optical disk for a given operation. Instead it identified various companies' experiences with the technology, and the results ranged from a high of 20:1 to less than 2:1. The Army program manager acknowledged that the Army overstated benefits when it computed savings using the 20:1 ratio. He stated that the Army should have used the results of one of its own studies that indicated a potential productivity gain of about 6:1. The difference in benefits for these two ratios (20:1 vs. 6:1) amounts to overstated savings of approximately $3.3 million (or 34 percent) in relation to the total benefit claimed of $9.5 million for this capability.

In addition to questionable benefits, the Army's economic analysis is based on repository profiles with certain size data bases and work-load requirements that have changed. Since this analysis was developed, the work-load requirements in two of the seven Army commands have changed considerably, but the economic analysis was not updated as

[6]The Impact of Automation on Engineering/Manufacturing Productivity, November 1980, Arthur D. Little, Inc.

required by DOD instructions. For example, in one command, the repository data base has been reduced by approximately 88 percent, from 800,000 drawings to only 100,000 drawings, but the economic analysis was not updated.

We also noted that the Army's economic analyses did not cover the full economic life of the seven Army command systems, as required by DOD Instruction 7041.3. Although the projected economic life for these systems is 9 to 10 years, the economic analysis covers a 5-year period. Army officials explained that this time frame was used because the systems were approved under the Army's printing regulation, which specifies a 5-year period for performing economic analyses for these types of systems. Thus, the Army did not include 4 to 5 years of projected costs and benefits in its economic analysis justifying the repository automation program.

To justify automating its repositories, the Air Force conducted an economic analysis based on information for one of its five repositories. DOD Instruction 7041.3 specifies that all resources required to achieve stated objectives are to be shown in the economic analysis. The Air Force's stated objectives are to automate its repositories at five air logistics centers. The Air Force's program director told us that the Air Force did not perform economic analyses on the other four repositories. Instead, it plans to do so before deciding to exercise current contract options for these four. As a result of this action, the full cost, scope, and complexity of the Air Force's repository automation effort have not been analyzed.

Further, the Air Force economic analysis overstated a principal benefit and did not include all pertinent costs associated with automating the one repository included in the analysis. The analysis estimates that the automated repository system, when compared to current manual operations, will generate $2.8 million in procurement savings to be achieved through increased competition. The analysis points out that the automated system will increase the availability of drawings needed for competition and will make the drawings more readable. Each of these activities is estimated to generate $1.4 million in procurement savings. However, we found that the Air Force repository had already installed equipment to enhance drawings. As a result, the economic analysis overstates the benefits of implementing the automated system by $1.4 million. Additionally, the undetermined costs associated with converting aperture cards into a form acceptable to the automation equipment was not reflected in the economic analysis.

Navy

To justify repository automation, the three Navy repositories with current projects, one at NAVAIR and two at NAVSEA, independently prepared an economic analysis. DOD Instruction 7041.3 specifies that all resources required to achieve stated objectives are to be shown in the economic analysis. The Navy's objective has been outlined in a Navy-wide automation plan as the automation and integration of all primary and secondary Navy repositories, not just the three current projects. As a result of the Navy's actions, the full cost, scope, and complexity of the Navy's repository automation efforts have not been analyzed.

We examined, in detail, NAVAIR's economic analysis for its repository and found it incomplete. The analysis was done before the team developing the system requirements became aware of the DOD stipulation that the system should be interoperable with other Navy and DOD repository systems. As a result, the analysis does not include $3 million in additional hardware and software capability to digitize data to meet interoperability requirements.

In addition, NAVAIR is moving away from aperture cards to digital technology, which also is being used by the Army and Air Force. Because the original analysis was prepared before the decision was made to digitize, it does not include an estimated $3 million that NAVAIR is proposing to acquire two optical mass-storage disks. Furthermore, the system proposed by NAVAIR now requires integration with its primary users. That cost was also not included in the original analysis and is now projected at about $9.4 million starting in fiscal year 1987. As a result, the NAVAIR economic analysis does not address capabilities that have subsequently been designed into the system.

DLA

To justify repository automation, DLA prepared a single economic analysis for its four repositories. That analysis contained assumptions that we believe are now out-of-date. For example, an estimate of the cost of storage equipment was predicated on the assumption that fiscal year 1982 work-load figures would be constant for the 10 years covered by the economic analysis. Since the analysis was written, DLA has received transfers from the military departments over and above the estimates. For example, one repository receives an additional 6,500 cards per month. As a result, the number of active cards is projected to increase from 288,000 in 1985 to 795,000 cards within 5 years after the automated equipment is installed. This increase will require doubling the number of storage modules, which will increase the cost of storage equipment.

On the basis of the repositories' collective requests for six additional storage modules, conveyers, and duplicator equipment, the cost of DLA's system could increase by 33 percent—from $5.1 million to $6.8 million. As a result of our review, DLA officials have acknowledged that the relationship of costs to benefits has changed, and the storage capacity problem requires them to reassess their storage needs and to update their economic analysis.

Military Departments and DLA Did Not Comply With Procurement Regulations

Federal regulations and DOD directives implementing Public Law 89-306 (Brooks Act) require DOD agencies to adopt a procurement strategy that not only meets their needs but also protects the government's interests. To achieve this, federal procurement regulations require agencies to obtain a Delegation of Procurement Authority from the General Services Administration to procure ADP equipment or services. Further, requirements must be stated in the least restrictive manner to encourage full and open competition and to ensure lower overall cost.

We found that the Army and Navy did not, in all cases, obtain Delegations of Procurement Authority from the General Services Administration. The Air Force did not need to acquire a delegation because the Army was the procurement agent responsible for purchasing the ADP system as part of the joint Army/Air Force effort. Although DLA obtained a Delegation of Procurement Authority, it did not request an amendment to reflect substantive changes in costs and requirements.

Army

Army officials stated that they acquired their systems under an Army printing regulation which, they believed, did not require them to obtain a Delegation of Procurement Authority. However, Federal Procurement Regulations[7] state that agencies must obtain a delegation when acquiring equipment that is dedicated to printing processes and uses computer technology, including electronic printing systems and integrated printing systems. The Army procurement, which will cost about $55 million, is largely composed of general-purpose computer hardware and associated software.

Army management officials stated they had only general knowledge of the federal ADP regulations and were unaware of the requirement that agencies must obtain a Delegation of Procurement Authority for printing systems. Since the Army's automated system is predominantly

[7]Federal Procurement Regulation 1-4.1102-1, footnote 5.

composed of general-purpose computers, General Services Administration officials have concluded that the Army should have obtained a Delegation of Procurement Authority. We agree with the General Services Administration.

Navy

The Navy did not obtain a Delegation of Procurement Authority because the Naval Material Command, the ADP approval authority for new systems, exempted the Navy's automation project from the ADP acquisition requirement. The command based its decision on the belief that the percentage of ADP equipment in the system was an incidental 10 to 15 percent of the system's total cost and thus was not subject to ADP acquisition requirements. Since the estimated cost of the automation system is $14.7 million and is predominantly composed of general-purpose computer equipment, General Services Administration officials have concluded that the Navy should have obtained a Delegation of Procurement Authority. We agree with the General Services Administration.

DLA

DLA obtained a Delegation of Procurement Authority from the General Services Administration, but it did not amend the request after its requirements and costs changed. DLA's Delegation of Procurement Authority states that failure to comply with the conditions established in the delegation will render it voidable. One of those conditions is that an amendment to the delegation must be obtained whenever any material change is expected from the basis on which the agency requested procurement authority, such as substantive revision of technical requirements, acquisition strategy, or anticipated contract costs.

DLA specified in its request for a Delegation of Procurement Authority its intention to automate two repositories and enhance or upgrade semiautomated systems at two other repositories. According to DLA, its objectives were to automate repositories and then to add digital capability as the technology became more reliable. DLA estimated equipment costs would be $4.9 million, maintenance costs for the systems over a 5-year period would be $2.2 million, and digital capability would cost another $3.4 million.

We found the following instances of substantive changes in technical requirements and anticipated contract costs:

- DLA acquired four new systems instead of its stated intention to acquire two systems and upgrade the other two.
- DLA's equipment needs were based on understated work-load data and may require an additional $1.7 million in equipment costs.
- DLA's maintenance costs have increased by more than $800,000 since the agency received its Delegation of Procurement Authority.
- DLA deleted its options for digital capability from the specifications, resulting in a substantive change to the contract's technical requirements.

A DLA official told us DLA did not seek to amend the Delegation of Procurement Authority because it did not perceive these changes as substantive enough. However, in our opinion, the above changes, in total, are significant. For example, equipment costs are projected to increase by $1.7 million, or 35 percent, and maintenance costs are projected to increase by $800,000, or 37 percent. Since the above changes are significant, General Services Administration officials believe DLA has exceeded its contract authority. We agree with the General Services Administration.

Restrictive Requirements Reduced Competition

Federal acquisition regulations state that agencies should avoid restrictive features that would limit acceptable offers to one or a few offerors' products, unless the features are essential to satisfy the agency's minimum needs. We found that the Army/Air Force solicitation had unnecessarily restrictive requirements, thereby limiting competition for computer hardware and software requirements.

In the solicitation for 12 Army and Air Force sites, the Army's requirements specified brand-name operating systems.[8] The specification required either of two specific operating systems. The restriction was included as a requirement based on an Army concept paper that recommended obtaining either of the two operating systems to ensure compatibility with other systems.

The Army, however, has not issued this concept paper as an Army-wide standard; nor has it developed an overall strategy that would necessitate such a restriction for its automated system. Additionally, the Army program manager for the Army/Air Force project told us that he was not aware of any unique system requirements that justified limiting the

[8]Operating systems—a group of computer programs that monitors and controls the operation of a computer system while the application programs are running.

operating systems packages. As a result, prospective bidders for the Army/Air Force contract were precluded from offering any operating systems other than the restrictive ones required.

We also noted other restrictions; for example, storage requirements were limited to optical-disk hardware. Why this restriction was made is unclear because the Army did not document its analysis of this requirement. An Army official who was a member of the team that developed the system requirements told us the team wanted what it perceived to be a technology that would not fade and would meet its requirements for large storage capacity. Yet other technologies, such as magnetic disks, could have satisfied the Army's needs. As a result of the restrictive requirement, potential prospective bidders for the Army/Air Force contract were precluded from offering nonoptical-based systems.

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DOD and PTO Can Benefit by Sharing New Technology

In 1981, PTO initiated a $720-million automation program intended to achieve paperless trademark and patent operations by 1990. PTO chose to use optical-disk storage devices, a new emerging technology, as a key element of this program. During this same period, the military departments and DLA were independently planning to spend a total of $144 million over 5 years on technical data repository automation efforts, which also included plans to use optical storage devices.

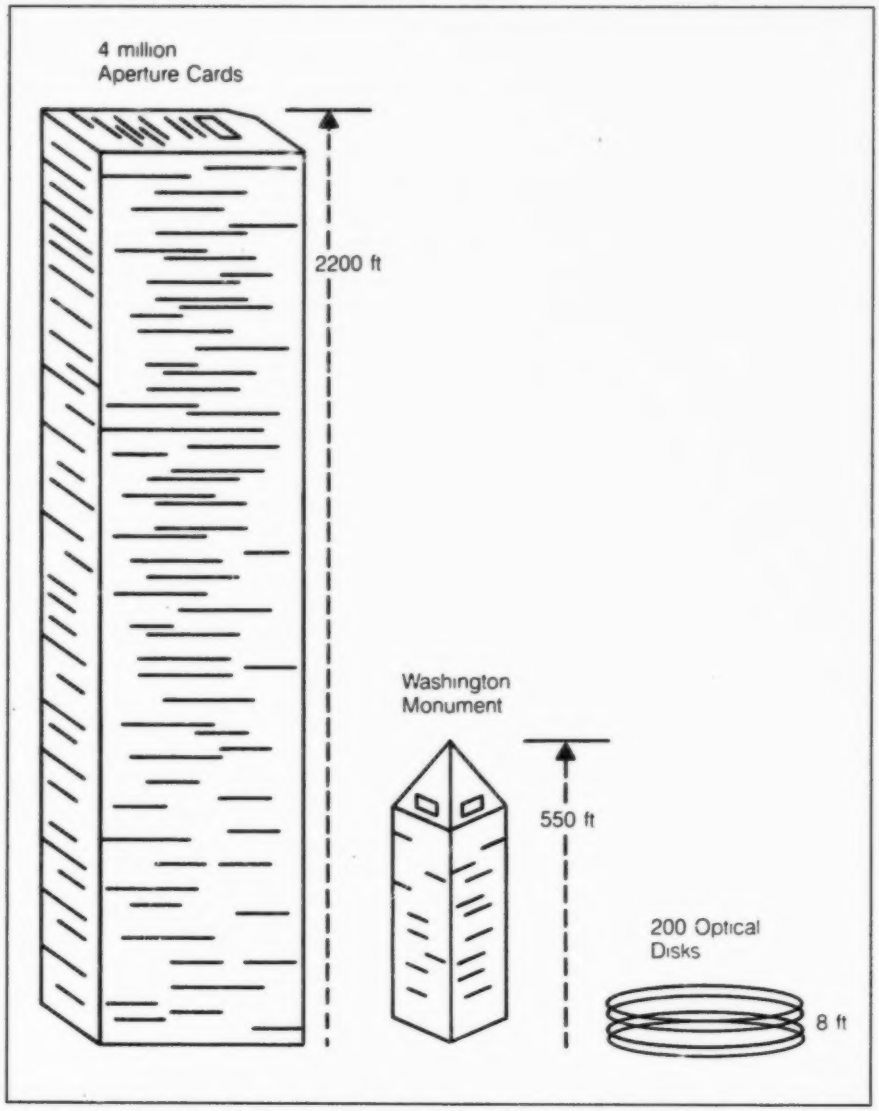
Under Public Law 96-511 (the Paperwork Reduction Act of 1980), government agencies are required to ensure that their information systems do not overlap one another or duplicate the systems of other agencies. Additionally, Office of Management and Budget Circular A-71 requires the head of each agency to consider merger or integration of data systems irrespective of intra-agency or interagency organizational lines, when cost effectiveness in equipment utilization, data systems management, or program accomplishment can be increased.

This chapter details the results of our review to (1) identify similarities between the military departments' automation efforts and a similar PTO effort and (2) determine if studies and tests on new technology being employed as part of these efforts should be shared. Because the DOD agencies and PTO are planning to use similar new technology, we believe they should formally coordinate and, when appropriate, perform joint studies (to include testing) of this technology.

Military Departments and PTO Have Similar Requirements for Optical-Disk Storage Devices

The joint Army/Air Force, Navy, and PTO projects all will use large-capacity, optical-disk storage devices in their system designs. While DLA is not currently implementing optical-disk technology in its project, the agency plans to do so when the technology is more mature. Traditionally, computers have relied on magnetic media, such as tape and in some cases large numbers of 80-column cards, to store data. However, cost performance of optical-disk technology has made it a potential competitor in the multibillion-dollar digital storage market. With their large capacity, optical disks can support the data bases of banks, insurance companies, government agencies, and other high-volume data users. Figure 4.1 shows a comparison of aperture-card and optical-disk media storage capabilities.

Figure 4.1: Storage Media Comparison



The above illustrates the relative storage capability of aperture cards (the current storage medium) as compared with digital optical disk. The Army estimates that 200 optical disks containing 400 billion characters of storage could store the alpha-numeric and graphics data contained on 4 million aperture cards in a representative Army repository.

Our review of PTO's automation effort and those of the military departments reveals the similarity in requirements for optical-disk use. The objective of PTO's Automated Patent System is to provide a broad range

of automated patent searching and administrative support functions for patent examiners, their support staff, and public searchers. The system is planned to include over 1,000 workstations and multiple large mainframe computers, connected by a high-performance digital communications network. The PTO system requires extensive use of optical storage for its rapid access and high-density storage subsystems. These are to be used for storing and searching digitized images of all patents and the full text of reference materials for more recent patents for automated searching.

The objectives of the joint Army/Air Force effort and two of the three Navy efforts under development are to store, retrieve, and communicate (transfer) vast amounts of engineering drawings, technical data packages used for procurement purposes, and other associated technical data required to support engineering and acquisition efforts. The systems are being designed to scan and digitize engineering drawings and associated technical documents for recording on optical disks. Additionally, these systems provide a range of output media, such as aperture card, hardcopy, and video.

Agency Actions Were Not Formally Coordinated

The military departments and PTO have not formally coordinated their plans to study, acquire, or test new technology. During our review, we noted some sharing of information among representatives of the Army, Air Force, Navy, PTO, and other government agencies, including the National Security Agency, the Social Security Administration, and the National Aeronautics and Space Administration. However, these contacts were ad hoc, informal, and initiated after agency representatives read in trade publications and newspapers that other agencies planned to employ optical-disk technology. In addition, agency representatives met while attending meetings, which were sponsored by the National Bureau of Standards, and other interagency functions concerned with emerging technologies. In our opinion, these ad hoc contacts did not permit the systematic analyses necessary to determine if joint actions could increase cost effectiveness.

Although PTO's Administrator for ADP told us that he personally contacted other agencies to comply with Circular A-71, he did not document information obtained from these contacts. PTO also did not formally consider joint studies or testing. Further, we found that the Army, Air Force, and Navy did not formally coordinate actions to ascertain if joint actions with other agencies would be in their best interests. Responsible DOD officials told us that they informally contacted other agencies,

including PTO, to find out how these agencies were using optical disks and to gather data regarding the feasibility of this technology. However, the DOD officials did not consider formal program coordination or joint action; they told us they were not aware of any requirement to do so.

The fact that optical-disk technology is new and operational experience with it is limited increases the risks of the military departments' and PTO's using this technology on a large scale. A September 1985 review of the technical aspects of PTO's automation plans by the National Bureau of Standards' Institute for Computer Sciences and Technology stated:

"The use of digital optical storage as an alternative to magnetic storage is only now emerging in the marketplace. There is currently an industry-wide shortage of optical storage media, which indicates there may be a problem in the delivery of the large number of optical disks required for the [Automated Patent System] APS. There is also a major unanswered question about the actual life expectancy of data stored on optical disk. The longest lifetime claimed by vendors is on the order of ten years, while laboratory tests have shown significant degradation in some cases in less than five years. The lack of availability and experience with optical storage media on a scale like that planned for the APS makes this a major risk area, but not as large as the systems integration risk."

The study's conclusions concerning availability of optical disks are further supported by data contained in a market survey and projection of optical disks shipped and installed from 1983 to 1990. The results of this survey, shown in table 4.1, indicate that only 15 large-capacity, optical-disk devices were installed in the United States as of 1985.

Table 4.1: Market Survey and Projection of U.S. Optical Storage Market

Year	Actual or planned shipments	Total no. installed
1983	5	5
1984	5	10
1985	5	15
1986	25	40
1987	300	340
1988	1,000	1,340
1989	1,500	2,840
1990	2,000	4,840

Because study and testing of such technology can be time-consuming and expensive, joint efforts in this regard by PTO and DOD seem prudent. Close coordination could reduce duplicate efforts, minimize study costs, and facilitate exchange of information in the federal community. An

example of duplicate study costs occurred in 1983 when PTO paid a contractor for a forecast and risk assessment of optical-disk use. In 1983, the Air Force paid the same contractor for a study that contained a similar forecast and risk assessment. Since the Army/Air Force and Navy efforts are still under way and since the military departments are attempting to reach decisions concerning the use of this technology, joint study and testing could be beneficial.

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Conclusions and Recommendations

Conclusions

The Chairman of the House Committee on Government Operations, in a May 24, 1985, letter to us, noted that the lack of scientific or technical data contributed significantly to an agency's inability to competitively procure spare parts for major systems. In addition, the media and the Congress have publicized overpricing problems in relation to these spare-parts procurements. DOD proposed that one solution to these problems was the automation of its technical data repositories.

In 1982, key technical data managers from the military departments, DLA, and the Office of the Secretary of Defense determined that automation was the best solution to technical data repository problems and that a standard system could be used to automate all of the repositories. In 1983, the Secretary of Defense provided policy direction confirming the above determination. He stated that a standard computer system specification had been defined for the automation of technical data repositories. He also noted that interoperability was a major benefit to be achieved from these efforts.

The military departments and DLA have initiated five separate automation efforts using three different automation technologies. We believe that these actions are not in consonance with the Secretary's memorandum.

Automating DOD's technical data repositories with a standard system, in our opinion, would be the most efficient and effective way to comply with the Secretary's policy. The current separate efforts present high risks in achieving standardization and interoperability. In addition, military department and DLA requirements, justifications, and economic analyses, were generally not properly prepared in implementing these separate efforts. Also, in two instances procurement regulations were not properly followed, and in one instance procurement authority was exceeded. In view of the serious problems identified in each of the current technical data repository automation efforts, we question whether it is prudent to continue with these efforts in their current forms.

We believe that the separate military department and DLA efforts occurred because DOD did not provide adequate management direction and control to ensure that the Secretary's policy was implemented cost effectively and efficiently. Specifically, we believe the Secretary's policy needed elaboration in terms of a comprehensive strategy and implementation guidance to clarify the Secretary's policy and coordinate the automation of the repositories. In addition, centralized focus within the Office of the Secretary of Defense to plan, coordinate, and review and

approve budgets was not used to ensure effective and efficient automation of the technical data repositories.

Further, DOD has not employed existing management procedures, including the DOD-established Life Cycle Management of Automated Information Systems concept and the Major Automated Information Systems Approval Process. The Life Cycle Management Concept provides a series of decision points for implementing major automation efforts. The Approval Process provides for an independent review of major automation efforts at these decision points. We believe these management control weaknesses are major contributors to the problems presented in this report.

Finally, we found that no formal coordination existed between PTO and DOD officials on sharing studies (including testing) of optical-disk technology efforts. In our opinion, such coordination would be useful in exercising future contract decisions concerning optical-disk technology implementation.

Recommendations to the Secretary of Defense

We recommend that the Secretary of Defense direct the Assistant Secretary of Defense for Acquisition and Logistics to take the following actions:

- In conjunction with the Assistant Secretary of Defense (Comptroller), expeditiously evaluate the appropriateness of continuing any or all of the current technical data repository automation efforts, considering the findings of this report and the Secretary's goal of standardization and interoperability. Results of this evaluation, including actions taken to delay or terminate any or all efforts, and the associated budgetary impacts should be presented to the Senate and House Appropriations Committees, the Senate Committee on Governmental Affairs, and the House Committee on Government Operations during the fiscal year 1987 appropriations cycle.
- Following the evaluation, designate oversight responsibility to a central office within the Office of the Secretary of Defense to manage and control any continuing efforts to automate the military departments' and DLA's repositories. This central office should have planning (to include setting overall objectives), coordination, and budget review and approval authority over the remaining military department and DLA repository automation efforts, and should obtain Delegations of Procurement Authority from the General Services Administration, as required by law.

- Require the aforementioned office to identify and consolidate military department and DLA requirements for the automation of the technical data repositories and develop a related DOD-wide economic analysis. These efforts should be performed regardless of the approach chosen as a result of the Secretary's evaluation and congressional actions, and should be conducted in accordance with the requirements of the Mission Analysis/Project Initiation phase of the Automated Information System Life Cycle.

We also recommend that the Secretary of Defense direct the Assistant Secretary of Defense (Comptroller) to conduct a Major Automated Information Systems Approval Process review for the automation of the DOD technical data repositories. This review, at a minimum, should include the life-cycle management documentation and decision papers prepared for the automation of all DOD repositories.

Recommendation to the Secretary of Defense and the Commissioner of the Patent and Trademark Office

We recommend that the Secretary of Defense direct the Assistant Secretary of Defense for Acquisition and Logistics and that the Commissioner of the Patent and Trademark Office direct the PTO Administrator for ADP to formally coordinate and, when appropriate, perform joint studies, including testing, of optical-disk storage devices.

Recommendations to the Congress

We recommend that the Congress delay any further funding of the technical data repository automation efforts until it receives the DOD evaluation. We also recommend that, after reviewing the evaluation and determining appropriate funding levels, the Congress ensure that these funds be restricted to the centrally directed effort.

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Letter Dated May 24, 1985, From the Chairman, House Committee on Government Operations

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The Honorable Charles A. Bowsher
Comptroller General
General Accounting Office
Washington, D.C. 20548

Dear General:

As you know, the 98th Congress enacted several important and far-reaching procurement reform measures to remove the barriers to competition which had long frustrated the efforts of many businesses to enter the Federal marketplace. One of the major issues addressed in these efforts was the government's right to and management of the scientific or technical data associated with the products being procured. The lack of such data contributed significantly to the agencies' inability to competitively procure their supplies, particularly spare parts for major systems.

Currently, several development projects, such as the Army/Air Force Digital Storage and Retrieval Engineering Data System (DSREDS), are planned or underway within the Defense Department to acquire ADP systems for the storage, retrieval, dissemination, and duplication of engineering drawings and other technical information. It is my understanding that these multimillion dollar projects have been independently initiated by the military services and DLA, and that they lack overall departmental coordination. I further understand that serious questions have been raised regarding duplication of effort, projected costs, procurement methodology, and the adequacy of the technology being acquired.

In view of the importance of the technical data issue, and the specific concerns regarding these ADP projects, I request the GAO immediately undertake a comprehensive department-wide review of this area, including a thorough analysis of DOD's policies and plans for improving the management of technical data. In addition to addressing the concerns mentioned above, GAO should determine if the individual ADP projects are well defined and based on valid requirements, and whether they should be consolidated into a single program at the department level. Also, as part of this request, GAO should identify similarities between these efforts and the ongoing project at the Patent and Trademark Office to determine whether the technology should be shared.

To facilitate the Committee's efforts during the 1987 authorization and appropriations cycle, I request that you provide the results of your review, including findings, conclusions and recommendations, by February 15, 1986. Your assistance in this matter is greatly appreciated.

With best wishes, I am

Sincerely,

JACK BROOKS
Chairman

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